REMARKS

Claims 1 - 3, 5 - 7 and 9 - 16 remain active in this application. Claims 4 and 8 have previously been canceled. Claims 11 - 16 have been withdrawn from consideration as being non-elected, without traverse, in response to a requirement for restriction. Claim 1 has been amended to improve clarity. No new matter has been introduced into the application.

Claims 1 - 3, 5 - 7, 9 and 10 have been rejected under 35 U.S.C. §112, second paragraph, as being indefinite; the Examiner criticizing the phrase "said copper layer at said location on said patterned copper layer" in claim 1. The remainder of the claims are included due to dependency. This rejection is respectfully traversed as being moot in view of the amendments to claim 1 made above.

Specifically, while it is unclear from the statement of the rejection why the Examiner finds this phrase to be indefinite (since, in context, it specifies the extent and location of the liner), the language of claim 1 has been rearranged and correspondence of antecedent language has been revised in an effort to improve clarity thereof. Therefore, it is respectfully submitted that any ambiguity which may have existed in claim 1 has been removed and reconsideration and withdrawal of the rejection is respectfully requested. Should the Examiner find that any issue of form or clarity remains, it is respectfully requested that the Examiner contact the undersigned by telephone at the number given below in order to expeditiously resolve the same.

Claims 1 - 3 and 5 - 7 have been rejected under 35 U.S.C. §103 as being unpatentable over Colgan et al. in view of Zhao et al. and claims 9 and 10 have been rejected under 35 U.S.C. §103 as being unpatentable over Colgan et al. in view of Zhao et al. and Jain et

al. These grounds of rejection are respectfully traversed.

While the clarification of how the Examiner seeks to apply the Colgan et al. reference is appreciated, it is respectfully submitted that Colgan et al. is completely irrelevant to the claimed invention. Colgan et al. is concerned with metal migration and not with the problems associated with different metallurgies in the different layers of interconnect structures. The interconnect structures can be any of copper, copper alloys, aluminum or aluminum alloys (column 4, lines 40 - 41, and column 5, lines 5 - 6) and, while studs 24 and 25, which form contacts to the chip, are formed of tungsten, studs 12 and 13, which connect metallization layer, are formed of a particular phase of a particular copper and aluminum alloy to provide "a source and path for Cu to move to both the upper and lower Al-Cu lines to reduce susceptibility to electromigration and thermal voiding as compared to tungsten" (column 3, lines 47 - 50). Moreover, the Examiner admits that Colgan et al. does not teach or suggest using a liner for use with either tungsten or copper alloy studs. Accordingly and further, Colgan et al. does not (and cannot) address the problem of copper corrosion or etching being caused by tungsten precursors during tungsten deposition.

Therefore, it is respectfully submitted that Colgan et al., as now applied by the Examiner, teaches less of relevance to the present invention than the admitted prior art by failing to even recognize the problem of copper corrosion or etching during tungsten deposition much less by the provision of a liner in which a tungsten stud is deposited and teaches away from the present invention by teaching the use of copper alloy studs rather than tungsten studs. By the same token, any modification of Colgan et al. which would even remotely approach answering the recitations

of the claims would be improper, regardless of the teachings or suggestions of any secondary reference(s), since the principal intended function (providing a source and path for copper to the Cu-Al lines) and meritorious effects (reduction of electromigration) of Colgan et al. would be lost. See In re Gordon, 221 USPQ 1125 (Fed. Circ., 1984). It also logically follows that such a suggested modification or combination is necessarily grounded in impermissible hindsight.

Substantively, Zhao et al. is directed to the formation of copper interconnections as a Damascene structure in a low dielectric constant insulator and indicates at column 4, lines 48 - 50, that a liner is necessary "to prevent the copper from interacting with surrounding material" (which is literally contrary to the use of a copper alloy stud as a source for copper in an interconnect of Colgan et al.) which can be damaged by copper diffusion or other material incompatibilities (column 4, lines 43 - 46) but does not teach or suggest use of a liner in a stud via *to protect the copper* much less from a tungsten precursor material. Therefore, while Zhao et al. might supplement the teachings of Colgan et al. to support a conclusion of obviousness of providing a liner to protect surrounding materials from interaction with copper or copper alloy studs, Zhao et al. teaches nothing or relevance to the protection of copper from corrosion or etching during deposition of a *tungsten* stud and does not even recognize the problem to which a solution is provided by the present invention, as claimed. Therefore, the combination of Colgan et al. and Zhao et al., even if proper cannot lead to an expectation of success in realizing the meritorious effects of the invention and thus cannot provide evidence of a level of ordinary skill in the art which would support the conclusion of obviousness which the

Examiner has asserted. Further, by confusing the stud materials of Colgan et al. and Zhao et al., the Examiner ha clearly failed to make a *prima facie* demonstration of obviousness of any claim in the application. For example, in regard to claim 2, the Examiner seems to be relying on the disclosure in Zhao et al. of tungsten *as a barrier material* rather than as a stud *per se*, as claimed, and, moreover, relies on its desirability as a *barrier* as motivation for the combination even though the combination would not answer the claims and the deposition of tungsten as a *barrier* for copper *before copper is deposited* does not *present* the problem of corrosion or etching of copper by the3 tungsten precursor.

Additionally, in regard to the statements of the rejection as to claims 3 and 5, it is respectfully submitted that the rejection is improper due to the references to Barth and Tobben which are not mentioned in the initial assertion of the rejection. Even if relied upon, these references do not properly supplement Colgan et al. and/or Zhao et al. for the reasons made of record in previous responses which are hereby fully incorporated by reference. It is also clear that Jain et al., applied to claims 9 and 10, does not mitigate the deficiencies of Colgan et al. and Zhao et al. discussed above for the reasons previously made of record and incorporated by reference.

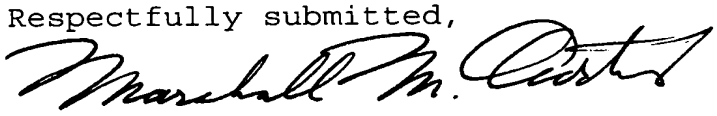
Accordingly, it is respectfully submitted that the Examiner has clearly not made a *prima facie* demonstration of obviousness of any claim in the application and that the asserted rejections are improper and in error for a large number of reasons as discussed above. The references relied upon simply do not support the conclusion of obviousness which the Examiner has asserted and are not properly combined while, even if properly combined, would not answer the recitations of the claims. Therefore, reconsideration

and withdrawal of the grounds of rejection and allowance of claims 1 - 3, 5 - 7, 9 and 10 is respectfully requested.

Since all rejections, objections and requirements contained in the outstanding official action have been fully answered and shown to be in error and/or inapplicable to the present claims, it is respectfully submitted that reconsideration is now in order under the provisions of 37 C.F.R. §1.111(b) and such reconsideration is respectfully requested. Upon reconsideration, it is also respectfully submitted that this application is in condition for allowance and such action is therefore respectfully requested.

If an extension of time is required for this response to be considered as being timely filed, a conditional petition is hereby made for such extension of time. Please charge any deficiencies in fees and credit any overpayment of fees to Deposit Account No. 09-0458 of International Business Machines corporation (E. Fishkill).

Respectfully submitted,



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